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Notice of Allowability	Application No. 09/974,679	Applicant(s) TSUBOUCHI ET AL.	
	Examiner Phuongchau Ba Nguyen	Art Unit 2616	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 8-25-6 amendment.

2. ☒ The allowed claim(s) is/are 1,3,12,13,15,16; renumberred as 1-6 respectively .

3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☒ All b) ☐ Some* c) ☐ None of the:

1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.

(a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached

1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.

(b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date 9-27-6.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date 9-27-6 .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DORIS H. TO
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

-SPECIFICATION:

Page 3, line 26; Page 4, line 16; Page 5, line 16; Page 6, line 9; Page 7, lines 15 & 23; Page 8, lines 9, 11 & 25; Page 9, line 27; Page 13, lines 16 & 27; Page 16, line 3; Page 17, lines 21, 23 & 24; Page 19, line 21; Page 21, lines 19 & 20; Page 22, line 15; Page 23, line 15; Page 25, lines 10, 11 & 12; Page 27, line 6; Page 28, lines 2, 4, 7 & 9; Page 29, lines 25, 26 & 27; Page 30, lines 2 & 10; Page 32, lines 5 & 8; Page 33, lines 23 & 25; Page 35, line 11,

"flame" had been changed to ---frame---.

4. The following changes to the drawings have been approved by the examiner and agreed upon by applicant:

-Figures 2-3, 9 & 17(b),

"flame" had been changed to ---frame---.

In order to avoid abandonment of the application, applicant must make these above agreed upon drawing changes.

REASONS FOR ALLOWANCE

5. The following is an examiner's statement of reasons for allowance:

Regarding claims 1, 3, 12-13, 15-16, the prior art of the record fails to teach a communication method over a cellular wireless communication network system, comprising "a packet of the packet CDMA communication method includes a frame composed of a preamble block having a barker code, an information block having an orthogonal M series codes, and information about a phase, wherein an absolute phase and reverse spreading are determined from the information about the phase included in the preamble block, and detected absolute phase and reverse spreading are subjected to a phase correction and a frequency offset correction, then resultant data is demodulated by an absolute synchronizing detection," which is considered in combination with other limitations, as specified in the independent claim 1.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phuongchau Ba Nguyen whose telephone number is 571-272-3148. The examiner can normally be reached on Monday-Friday from 10:00 a.m. to 2:00 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Doris To can be reached on 571-272-7629. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service

Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PChau

Phuongchau Ba Nguyen
Examiner
Art Unit 2616

Approved
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Fig. 2

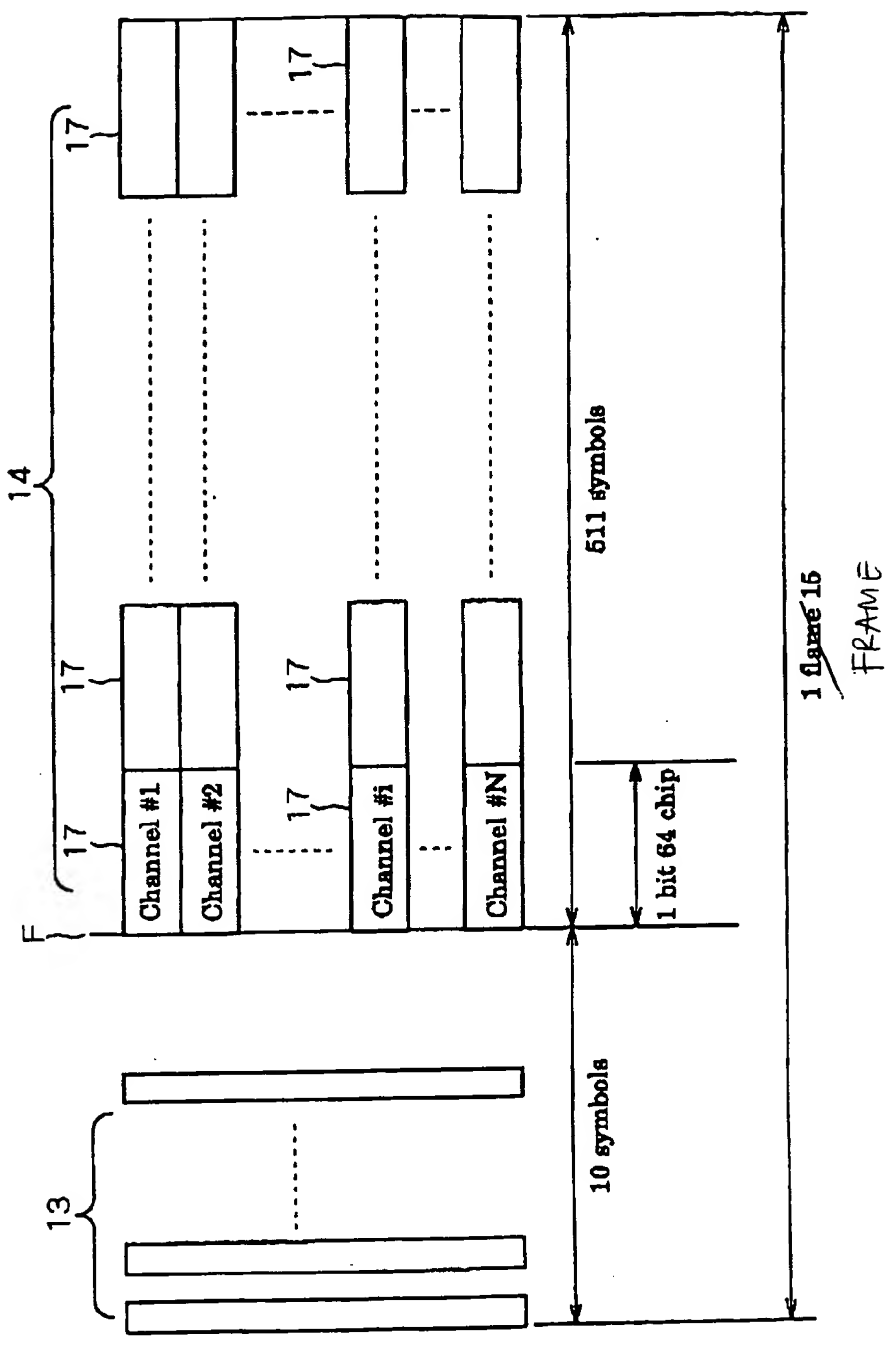

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Fig. 3

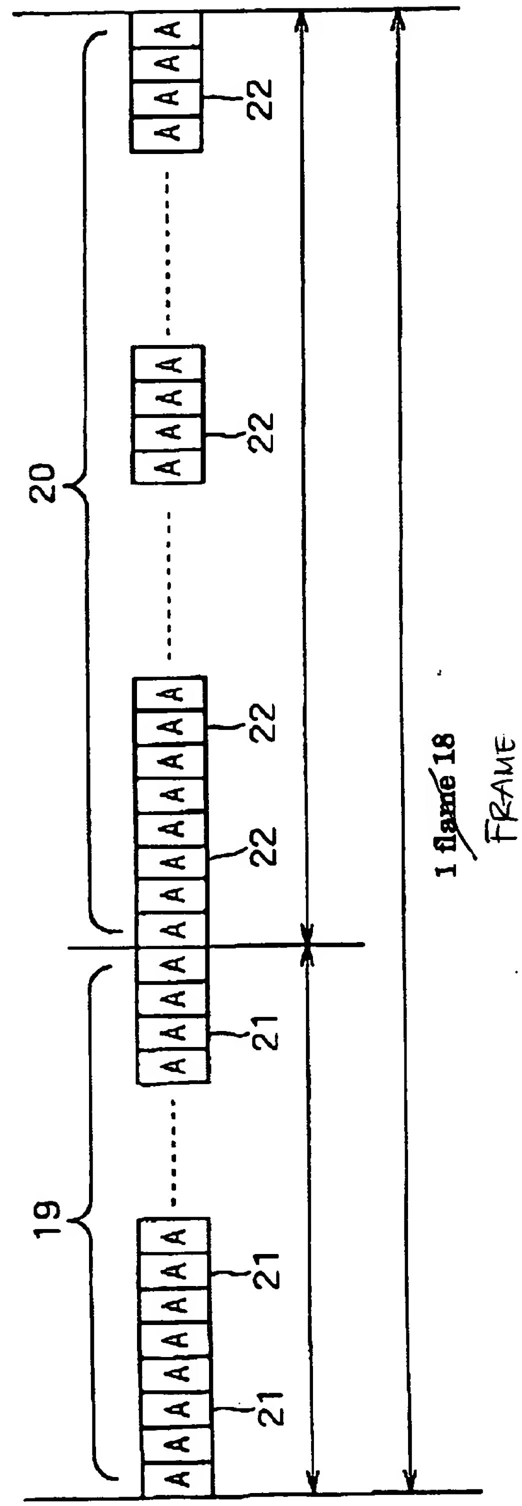

Fig. 9

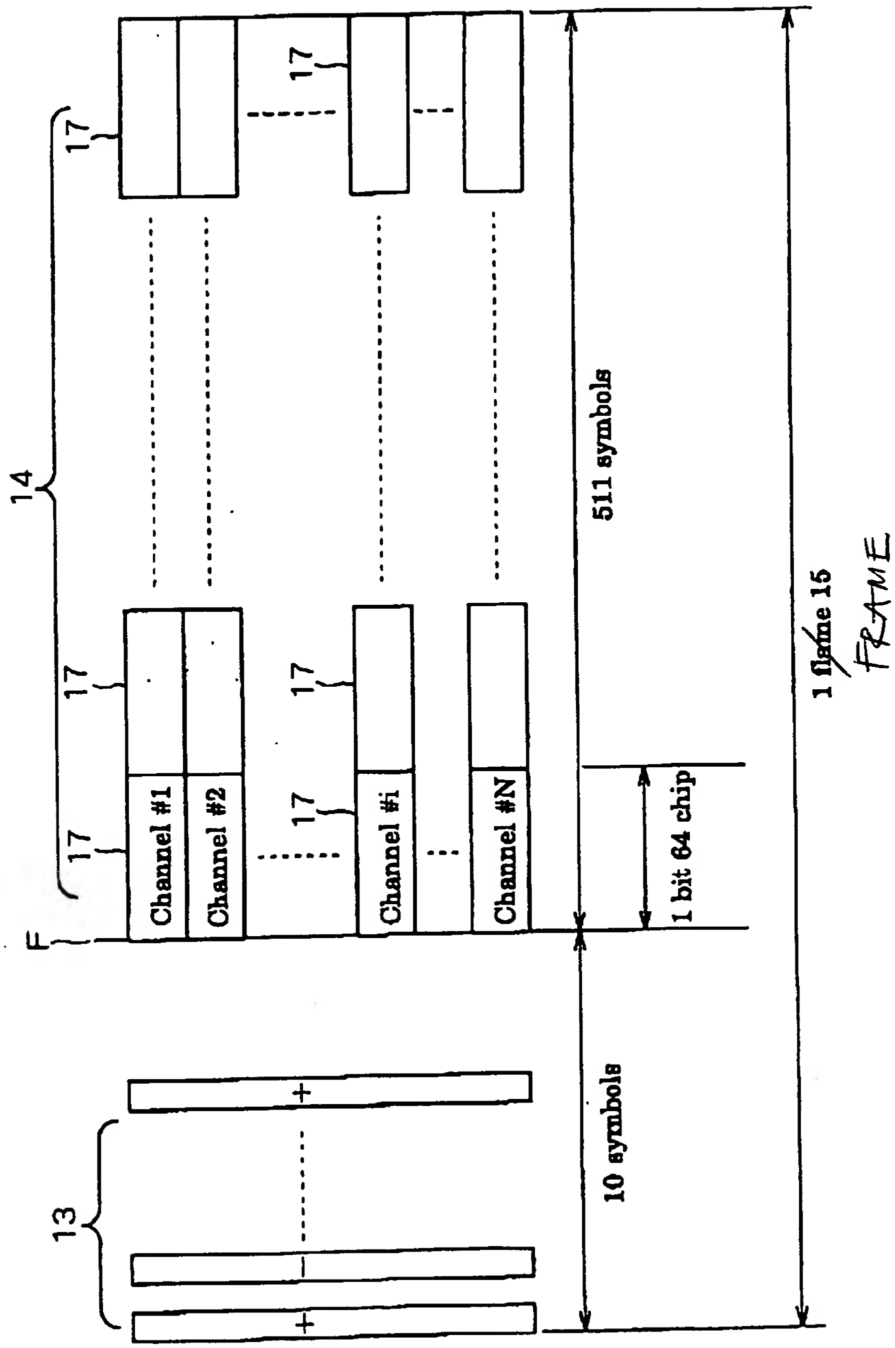

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Fig. 17 (a)

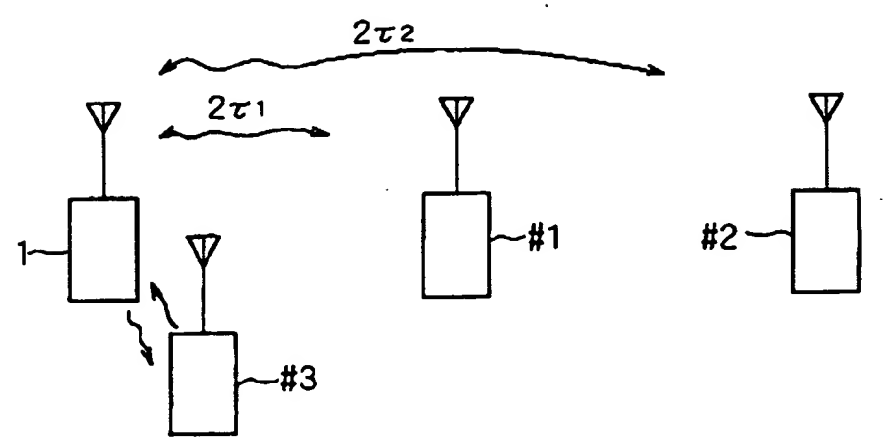


Fig. 17 (b)

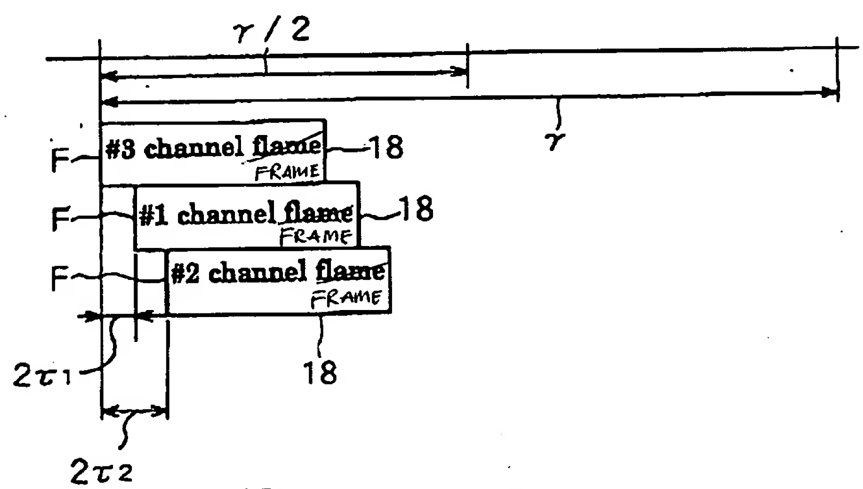
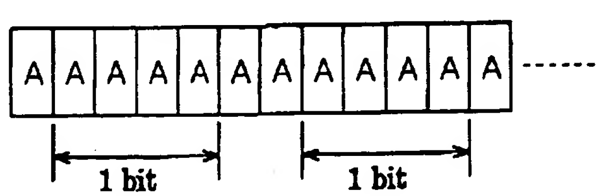


Fig. 17 (c)



arrangement for the base station location is improved to realize a construction of the communication network with inexpensive cost.

SUMMARY OF THE INVENTION

To achieve the above described object, in accordance with a first aspect of the present invention, a cellular wireless communication network system comprising a plurality of base stations and a plurality of mobile stations, wherein the base stations are connected together with the wireless communication, is provided.

In accordance with a second aspect of the present invention, a wireless communication network system according to the first aspect of the invention, wherein the wireless communication with which the base stations are connected together, is achieved by an OFDM communication method, is provided.

In accordance with a third aspect of the present invention, a wireless communication network system according to the first aspect of the invention, wherein the wireless communication with which the base stations are connected together, is achieved by an AS-CDMA communication method, is provided.

In accordance with a forth aspect of the present invention, a wireless communication network system according to the first aspect of the invention, wherein communication between one of the base stations and the mobile stations is achieved by the packet CDMA communication method, is provided.

In accordance with a fifth aspect of the present invention, a wireless communication network system according to the second or third aspect of the invention, wherein one ~~flame~~ FRAME of a packet of the communication method achieved by the packet CDMA communication

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method, is composed of a preamble block including the barker code and an information block including M series codes which are orthogonal each other, is provided.

In accordance with a sixth aspect of the present invention, a wireless communication network system according to any one of the first to the fifth aspects of the invention, wherein the communication between the base station and the mobile stations, is achieved by a multicode transmission method for both of a downlink and an uplink, is provided.

In accordance with a seventh aspect of the present invention, a wireless communication network system according to the sixth aspect of the invention, wherein the multicode transmission method is achieved by that: the data are assigned to a plurality of different orthogonal spread code; the data assigned to the respective orthogonal code are combined together at the same time to compose one information block; and the information block is added after the preamble block to compose the one FRAME ~~flame~~ when the information is transmitted, is provided.

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In accordance with an eighth aspect of the present invention, a wireless communication network system according to the seventh aspect of the invention, wherein the multicode transmission method is achieved by that: the information block is detected by a detection of the preamble; the spread code are reversely spread after a synchronization of the respective spread code has established which are included in the information block; and the whole information is demodulated by demodulation of the data based on the respective spread code and synthesizing the respective data when the information is received, is provided.

According to the first to the eighth aspects of the invention, because the communication circuit without wire can be established between the

base stations, the flexibility of arrangement for base station location is improved, and it causes to realize a construction of communication network with inexpensive cost.

In accordance with a ninth aspect of the present invention, a wireless communication network system according to any one of the first to fifth aspects of the present invention, wherein the communication between the base station and the mobile stations, is achieved by a M-array transmission method for both of a downlink and an uplink, is provided.

In accordance with a tenth aspect of the present invention, a wireless communication network system according to the ninth aspect of the invention, wherein the M-array transmission method is achieved by that: the data are divided and the orthogonal spread code are assigned to the every data respectively; the spread code are selected in order of time base and combined together to compose one information block; and the information block is added after the preamble block to compose the one ~~flame~~ FRAME of the data when the information is transmitted, is provided.

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In accordance with an eleventh aspect of the present invention, a wireless communication network system according to the tenth aspect of the invention, wherein the M-array transmission method is achieved by that: the information block is detected by a detection of the preamble; after the synchronization of the respective orthogonal spread code which are included in the information block, has established, a number of reverse spread code are generated, the number of which corresponds to the number of orthogonal spread code used based on the synchronizing signal; after the respective orthogonal spread code which are included in the information block are reversely spread, the data are demodulated through the integral networks by comparing the resulted integrated value made by the

respective integral networks when the information is received, is provided.

According to the tenth and eleventh aspects of the invention, a transmission speed can be improved.

In accordance with a twelfth aspect of the present invention, a wireless communication network system according to any one of the first to fourth aspects of the invention, wherein the communication between the base station and the mobile stations, is achieved utilizing the approximate synchronized CDMA method at the uplink, and wherein the packet is composed of the one ~~flame~~ FRAME which includes a synchronizing block and an information block which are arranged in this order, and the information block is the approximate synchronized CDMA code, is provided.

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According to the twelfth aspect of the invention, because the approximate synchronized CDMA can be composed of the matched filter with short coded and the sliding correlater, it is possible to realize lower energy consumption.

In accordance with a thirteenth aspect of the present invention, a wireless communication network system according to the twelfth aspect of the invention, wherein the communication between the base station and the mobile stations, is achieved by that an information about the phase is included on the preamble portion, and the cell information about the cell is provided by the information about the phase at the downlink, is provided.

According to the thirteenth aspect of the invention, it is possible to intend an improvement of the efficiency of transmission.

In accordance with a fourteenth aspect of the present invention, a wireless communication network system according to the thirteenth aspect of the invention, wherein the communication between the base station and the mobile stations, is achieved by that an absolute phase is detected by

the phase information on the preamble portion as a reference phase, and the data are subjected to the phase correction and the frequency offset correction after reverse spreading, then the data are demodulated by the absolute synchronizing detection at the downlink, is provided.

According to the fourteenth aspect of the invention, because the efficiency of demodulation is improved, the energy per 1 bit (Eb) / noise power per 1 Hz (NO) which is required for the transmission, can be reduced.

In accordance with a fifteenth aspect of the present invention, a wireless communication network system according to any one of the first to the fourteenth aspects of the invention, wherein said base station takes the correlation of the uplink at the receiving portion and then detects the receiving timing, calculate a timing that said receiving timing becomes the most suitable, inserts the most suitable timing as the timing controlling information into the ~~flame~~ FRAME for downlink and send the data, is provided.

In accordance with a sixteenth aspect of the present invention, a wireless communication network system according to the fifteenth aspect of the invention, wherein the mobile station establishes the synchronization of the spread code by detecting the spread code in the preamble portion at the receiving portion of the downlink, after making the reverse spreading of the spread code, demodulates the data through the integral networks, then extracts the transmission timing control information which is inserted in the received ~~flame~~ FRAME, controls the chip timing of the reverse spread code based on the transmission timing controlling information and transmit the data as the uplink, is provided.

According to the fifteenth and sixteenth aspects of the invention, because the transmission timing of uplink can be controlled by that the

timing control information for the uplink is inserted into the downlink, the shortening of an interval for the approximate synchronization of the approximate synchronized CDMA can be intended and an improvement of the transmission speed and an increase of the channel number can be expected.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of the base station in accordance with the embodiment 1 of the present invention.

Fig. 2 is a diagram which shows a format of a one ~~flame~~ FRAME of the packet CDMA used for a downlink.

Fig. 3 is a diagram which shows a format of one ~~flame~~ FRAME of the approximate synchronized CDMA used for an uplink.

Fig. 4 is a block diagram which shows a first example of structure for the packet CDMA transmitter shown in Fig. 1.

Fig. 5 is a block diagram which shows an example of structure for a receiver of the mobile station corresponding to the packet CDMA transmitter shown in Fig. 4.

Fig. 6 is a block diagram which shows a second example of structure for the packet CDMA transmitter shown in Fig. 1.

Fig. 7 is a block diagram which shows another example of structure for a receiver of the mobile station corresponding to the packet CDMA transmitter shown in Fig. 6.

Fig. 8 is a block diagram which shows a third example of structure for the packet CDMA transmitter shown in Fig. 1.

Fig. 9 is a diagram which shows a format of the one ~~flame~~ FRAME of the packet CDMA used for the packet CDMA transmitter shown in Fig. 8.

Fig. 10 is a block diagram which shows an example of structure for

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a receiver of the mobile station corresponding to the packet CDMA transmitter shown in Fig. 8.

Fig. 11 is a block diagram which shows a first example of structure for a transmitter of the mobile station.

Fig. 12(a) is a diagram showing an example of the information transmission spread code data used in the uplink, and shows one example of the information transmission spread code data.

Fig. 12(b) shows another example of the information transmission spread code data which are different from the information transmission spread code data shown in Fig. 12(a).

Fig. 13 is a block diagram which shows an example of structure for an AS-CDMA receiver of the base station corresponding to the mobile station shown in Fig. 11.

Fig. 14 is a block diagram which shows a second example of structure for a transmitter of the mobile station.

Fig. 15 is a block diagram which shows an example of structure for an AS-CDMA receiver of the base station corresponding to the mobile station shown in Fig. 14.

Fig. 16 is a block diagram which shows a variation of the base station shown in Fig. 1.

Fig. 17(a) is an explanatory diagram of the transmission delay time during a communication between the base station and the mobile station, and it is a diagram schematically showing a location of the mobile station with regard to the base station.

Fig. 17(b) is an explanatory diagram of transmission delay time during a communication between the base station and the mobile station and is an explanatory diagram showing a time lag of the first ~~flame~~ of the
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the uplink (upward circuit) and the downlink (downward circuit).

A flame 15 of the packet of packet CDMA, as shown in Fig. 2, is made up from a preamble block 13 and an information block 14.

Herein, the preamble block 13 is a code block containing a column of sequential synchronous codes to secure the chip synchronism of orthogonal code at the receiver side. This preamble block 13 is used to establish the synchronism at the mobile station #i side, and a common code is used for all mobile stations #i. The information block 14 is the block in which the information is coded.

In this embodiment, a barker code is used for the preamble block 13. A chip rate of the barker code is, for example, 22 Mcps. The preamble block 13 is made up from, for example, 11 chips. An orthogonal M series code is used in the information block 14. A chip rate of the orthogonal M series code is, for example, 11 Mcps. The N channel of the orthogonal M series code is assigned to each mobile station #i severally.

The ~~flame~~ FRAME 15 according to an embodiment of the present invention, is made up from, for example, 10 symbols of the preamble block 13 and, for example, 511 symbols of the information block 14. The information block 14 is made up from N channels. Each information symbol 17 is made up from, for example, 64 chips. By this arrangement, 511 bit of information can be transmitted when the information block 14 has 511 symbols and one symbol one bit transformation is employed.

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The packet CDMA transmitter 6 is made capable to send information with arithmetic addition of the information of all channels to all respective mobile stations #i within an area of the base station 1.

The AS-CDMA means the information transmission spread code. In this approximate synchronized CDMA, a one ~~flame~~ FRAME 18 of the

other base station, the data flow controller 3 achieves a required process to transmit it to the other base station.

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The packet CDMA transmitter 6 makes the ~~flame~~ 15 of the packet CDMA based on the information, and outputs it to the TDD changing apparatus 9. The TDD changing apparatus 9 connects the packet CDMA transmitter 6 to the transmitting/receiving antenna 12 for communication within the cell because the information is a transmission from base station to the mobile station (downlink).

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In this embodiment a description will be given supposing that the communication is made between the mobile station #1 which is shown in Fig. 1 and a mobile station which is located within the area of the other base station. The other mobile stations #3 to #N also have been used for communication with other stations at the same time.

[First example of a structure for the packet CDMA transmitter 6]

In this embodiment the packet CDMA transmitter 6 is made to have a structure with which a simultaneous transmission of the information can be achieved to the first mobile station #1 by means of two channels #1 and #2 as shown in Fig. 4.

The information sent from the data flow controller 3 has been distributed to a data divider 23 and information transmission spread code generator $24_{\#i}$ (i is an integer from 3 to N) by the data flow controller 3. The data divider 23 has the function to divide the information which has been sent, into two portions to simultaneously transmit them using the two channels #1 and #2.

A front part of the divided information is input to the information transmission spread code generator $24_{\#1}$. A back part of the divided information is input to the information transmission spread code generator

$24_{\#2}$. The residual information for the mobile station is input to the corresponding information transmission spread code generator $24_{\#i}$ (i is an integer from 3 to N) respectively.

Each information transmission spread code generator $24_{\#i}$ (i is an integer from 1 to N) assigns, for example, one bit of the information to, for example 64 chips of the orthogonal spread code (M series code) and generates the information transmission spread code data. This information transmission spread code data are input to the spread code generator 26. The information transmission spread code data are designated in $C_{\#i}$ (i is an integer from 1 to N).

The spread code generator 26 makes an information block 14 consisted of 511 symbols with an arithmetic addition of information transmission spread code data from all N channels. The arithmetic addition data is designated in SUM_j (j is an integer from 1 to 511).

Herein, $SUM_j = (C_{\#1} + C_{\#2} + \ldots + C_{\#n} + \ldots + C_{\#N})_j$

The arithmetic addition data SUM_j is input to the spread code selecting apparatus 28 in combination with the output from a preamble spread code generator 27.

The preamble spread code generator 27 generates the preamble block 13 consisted of 10 symbols of the barker code. The spread code selecting apparatus 28 is controlled by a ~~flame~~ FRAME structure controller 29. The spread code selecting apparatus 28 combines the data of the preamble block 13 and the data of the information block 14, and composes the ~~flame~~ FRAME 15. The data composing the ~~flame~~ FRAME 15 is output through the TDD changing apparatus 9 to a D/A converter 30. The D/A converter 30 converts the data from that in digital form to that in analog form. The D/A converted data are input to the RF. IF circuit 31 as the analog signal.

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The spread code synchronization establishing apparatus 37 generates a synchronization signal based on the preamble block 13. The synchronization signal is output to information transmission spread code generators $38_{\#1}$ and $38_{\#2}$.

The information transmission spread code generators $38_{\#1}$ and $38_{\#2}$ generate the information transmission spread code data and output the information transmission spread code data to the reverse spreading apparatus $36_{\#1}$ and $36_{\#2}$. The reverse spreading apparatus $36_{\#1}$ and $36_{\#2}$ have the function to calculate the logical multiplication.

In the information transmission spread code, a sign is used that is arranged to produce a square of itself ($C_{\#i}$ x $C_{\#i}$) when a logical multiplication is made with itself, and that produces zero when a logical multiplication is made with others ($C_{\#i} \times C_{\#k} = 0$ for $i \neq k$).

By this arrangement, when the logical multiplication is taken on $C_{\#1}$ with the arithmetic addition data $SUM_j = (C_{\#1} + C_{\#2} + ... + C_{\#i} + ... + C_{\#N})_j$, the result $C_{\#1}$ x $C_{\#1}$ can be gained. And also when the logical multiplication is taken on C#2 with the arithmetic addition data $SUM_j = (C_{\#1} + C_{\#2} + ... + C_{\#i} + ... + C_{\#N})_j$, the result $C_{\#2}$ x $C_{\#2}$ can be gained.

Because of this, the reverse spreading apparatus $36_{\#1}$ and $36_{\#2}$ output the logical multiplication data $C_{\#1}$ x $C_{\#1}$ and $C_{\#2}$ x $C_{\#2}$, respectively. Because the information symbol 17 of the one ~~flame~~ FRAME 15 has j of 511, 511 pieces of the logical multiplications $C_{\#1}$ x $C_{\#1}$ and $C_{\#2}$ x $C_{\#2}$ are totally output.

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These logical multiplications $C_{\#1}$ x $C_{\#1}$ and $C_{\#2}$ x $C_{\#2}$ are input to data demodulating apparatus $39_{\#1}$ and $39_{\#2}$ respectively. The data demodulating apparatus $39_{\#1}$ and $39_{\#2}$ demodulate the data based on the logical multiplications signal $C_{\#1}$ x $C_{\#1}$ and $C_{\#2}$ x $C_{\#2}$. The modulated data

are input to a spread code selecting apparatus 32. To the spread code selecting apparatus 32, another data is also input from the data flow controller 3. The spread code selecting apparatus 32 decides that which information transmission spread code data (orthogonal spread code) is arranged in order of time corresponding to the data, "+,-", "00", "01", "10" and "11".

The information transmission spread code data which is selected by the spread code selecting apparatus 32, is input to the spread code generator 26. The information transmission spread code generators after the fifth channel $24_{\#5}$, ..., $24_{\#i}$, ..., $24_{\#N}$ are assigned to the mobile stations #5 - #N.

The information transmission spread code data are also input into the spread code generator 26. The spread code generator 26 outputs an information block 14 consisted of 511 pieces of the arithmetic addition data SUM_j. The arithmetic addition data SUM_j are input to the spread code selecting apparatus 28.

The spread code selecting apparatus 28 combines the data of the preamble block 13 and the data of the information block 14 to compose a ~~flame~~ FRAME 15 under a control by the ~~flame~~ FRAME structure controller 29. The data composing of the ~~flame~~ FRAME 15 is output to the D/A converter 30 through the TDD changing apparatus 9. The D/A converter 30 converts the data from that in digital form to that in analog form. The data which are converted from the digital form to the analog form, are input to the RF. IF circuit 31 as the analog signal.

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The RF. IF circuit 31 modulates the analog signal based on the frequency modulation method. The frequency modulated analog signal is transmitted (downlink) from the transmitting/receiving antenna 12 for

communication within the cell to the respective mobile stations #i (i = 1,5, ..., N) within the cell 2 of the base station 1.

The information which has the adjusted top end portion F of the information block 14 is received by the respective mobile stations #1, #5, ..., #i, ..., #N located within the cell 2 of the base station 1. This method is called a M-array transmission.

In this embodiment because four channels are assigned to the mobile station #1, the number of mobile stations that the base station 1 is controlling, is N-4.

Further the information transmission spread code generator $38_{\#1}$ - $38_{\#4}$ is corresponded to by 3 bits in case when the BPSK is employed for the phase modulation, or 4 bits in case when the QPSK is employed, or much more bits when in the case the multi value modulation is employed. According to the fact, when in the case the information block 14 of the one ~~flame~~ FRAME 15 is made up from 511 symbols and the BPSK is employed for the phase modulation, the data consisting of 12 x 511 bit can be sent for downlink at a time.

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[Second example of a structure for the mobile station #1]

Fig. 7 illustrates a structure of the receiver of the mobile station #1 corresponding to the packet CDMA transmitter 6 shown in Fig. 6.

The RF. IF circuit 33 detects the radio wave which comes from the base station 1, and outputs the analog signal to the A/D converter 34. The A/D converter 34 digitally converts the analog signal into the information data.

The information data are input to the preamble spread code detecting apparatus 35 and the reverse spreading apparatus $36_{\#1}$, $36_{\#2}$, $36_{\#3}$ and $36_{\#4}$. The preamble spread code detecting apparatus 35 detects the

barker code and outputs the barker code data to the spread code synchronization establishing apparatus 37.

The spread code synchronization establishing apparatus 37 generates a synchronization signal based on the preamble block 13. The synchronization signal is output to the information transmission spread code generators $38_{\#1}$, $38_{\#2}$, $38_{\#3}$ and $38_{\#4}$.

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The information transmission spread code generators $38_{\#1}$, $38_{\#2}$, $38_{\#3}$ and $38_{\#4}$ generate the information transmission spread code data and output the information transmission spread code data to the reverse spreading apparatus $36_{\#1}$, $36_{\#2}$, $36_{\#3}$ and $36_{\#4}$. The reverse spreading apparatus $36_{\#1}$, $36_{\#2}$, $36_{\#3}$ and $36_{\#4}$ have the function to calculate the logical multiplication.

The reverse spreading apparatus $36_{\#1}$, $36_{\#2}$, $36_{\#3}$ and $36_{\#4}$ output the logical multiplication data $C_{\#1}$ x $C_{\#1}$, $C_{\#2}$ x $C_{\#2}$, $C_{\#3}$ x $C_{\#3}$ and $C_{\#4}$ x C#4 respectively. The information symbol 17 of the one ~~flame~~ FRAME 15 has j of 511. Accordingly, 511 pieces of the logical multiplications $C_{\#1}$ x $C_{\#1}$, $C_{\#2}$ x $C_{\#2}$, $C_{\#3}$ x $C_{\#3}$ and $C_{\#4}$ x $C_{\#4}$ are totally output.

These logical multiplications $C_{\#1}$ x $C_{\#1}$, $C_{\#2}$ x $C_{\#2}$, $C_{\#3}$ x $C_{\#3}$ and $C_{\#4}$ x $C_{\#4}$ are respectively input to the integral networks $42_{\#1}$, $42_{\#2}$, $42_{\#3}$ and $42_{\#4}$. The integral networks $42_{\#1}$, $42_{\#2}$, $42_{\#3}$ and $42_{\#4}$ carry out the integral calculations based on the logical multiplications $C_{\#1}$ x $C_{\#1}$, $C_{\#2}$ x $C_{\#2}$, $C_{\#3}$ x $C_{\#3}$ and $C_{\#4}$ x $C_{\#4}$, and output the resulted integral signals.

The integral signals are respectively input to a integral signal comparing apparatus 43. The integral signal comparing apparatus 43 has a look up table which has already been prepared. In the look up table, there is a specified corresponding relation between the two bit data and an integrated peak value.

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information transmission spread code generators of the respective mobile stations #1, #5, ..., #N within the cell 2, and a control information which controls the frequency of the RF.IF circuit 33 are recorded. The respective barker codes in the preamble block 13 which are generated by the preamble spread code generator 27, are input into a spread code reversing apparatus 46. The spread code reversing apparatus 46 reverses a sign of the respective barker codes in the preamble block 13 based on the control information in the cell information recording apparatus 45, and outputs them to the spread code selecting apparatus 28.

The spread code selecting apparatus 28 composes the one ~~flame~~ FRAME 15 shown in Fig. 9 based on the controlling by the ~~flame~~ FRAME control apparatus 29. The data which are made up from the one ~~flame~~ FRAME 15, are modulated and achieved a downlink to respective mobile stations #1, #5, ..., #N within the cell 2 of the base station 1 from the transmitting/receiving antenna 12 for communication within the cell. Because the other structure of the embodiment is the same as the packet CDMA transmitter 6 shown in Fig. 6, the detailed description will be omitted.

In this embodiment, though the structure was employed in which the cell information recording apparatus 45 and the spread code reversing apparatus 46 are provided within the packet CDMA transmitter 6 shown in Fig. 6, another structure may be applicable in which the cell information recording apparatus 45 and the spread code reversing apparatus 46 are provided within the packet CDMA transmitter 6 shown in Fig. 4.

[Third example of a structure for the mobile station #1]

Fig. 10 is a block diagram of a third example of structure for a receiver of the mobile station #1. In this third example of structure, the receiver of the mobile station #1 is provided with a cell information judging

of the information, the efficiency of use of the information transmission can be improved in such extent.

[First example of a structure for the transmitter of the mobile station #1]

In this embodiment the mobile station #1 comprises a data dividing apparatus 49, an information transmission spread code generator 50, a preamble spread code generator 51, a ~~flame~~ FRAME structure controller 52, a spread code synthesizing apparatus 53, a spread code selecting apparatus 54 and a D/A converter 55, as shown in Fig. 11.

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The upper application layer 41 outputs the data to the data dividing apparatus 49. The data dividing apparatus 49 achieves the function to divide the data into two portions utilizing the #1 channel and #2 channel. A front portion of the divided data are input to information transmission spread code generator $50_{\#1}$. A back portion of the divided information is input to the information transmission spread code generator $50_{\#2}$.

The information transmission spread code generator $50_{\#1}$ generates the information transmission spread code data $C_{\#1}$ shown in Fig. 12(a) in every 1 symbol. The information transmission spread code generator $50_{\#2}$ generates the information transmission spread code data $C_{\#2}$ shown in Fig. 12(b) in every 1 symbol. These information transmission spread code data $C_{\#1}$ and $C_{\#2}$ are input to the spread code generator 53. The spread code generator 53 makes an arithmetic addition of information transmission spread code data $C_{\#1}$ and $C_{\#2}$ and outputs SUM_j (j is an integer from 1 to 511) to compose an information block 20 consisted of 511 symbols.

The preamble spread code generator 51 generates an information symbol 21 of the preamble block 19 shown in Fig. 3. A signal making the information symbol 21 is input in combination with the arithmetic addition

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data SUM_j to the spread code selecting apparatus 54. The spread code selecting apparatus 54 makes the one ~~flame~~ FRAME 18 (see Fig. 3) consisting of the data of the preamble block 19 and the data of the information block 20 by the ~~flame~~ FRAME structure controlling apparatus 52. This one ~~flame~~ FRAME 18 is an approximate synchronized CDMA signal consisting of the repetition of the same codes which have 16 chips in units.

The data making the one ~~flame~~ FRAME 18 is input to the D/A converter 55. The D/A converter 55 converts with digital to analog conversion meted the approximate synchronized CDMA data consisting of the one ~~flame~~ FRAME 18. The analog signal is modulated by the RF. IF circuit 33, and transmitted (uplink) from the transmitting/receiving antenna 32 to the base station 1.

[First example of a structure for the AS-CDMA receiver 7 of the base station 1]

Fig. 13 is a block diagram of an AS-CDMA receiver $7_{\#1}$ corresponding to the mobile station #1 shown in Fig. 11.

In this embodiment the AS-CDMA receiver 7 comprises a preamble spread code detecting apparatus 56, a spread code synchronization establishing apparatus 57, information transmission spread code generator $58_{\#1}$, $58_{\#2}$, reverse spreading apparatus $59_{\#1}$, $59_{\#2}$, data demodulation apparatus $60_{\#1}$, $60_{\#2}$ and a data synthesizing apparatus 61.

The function of the preamble spread code detecting apparatus 56, the spread code synchronization establishing apparatus 57, the information transmission spread code generators $58_{\#1}$, $58_{\#2}$, the reverse spreading apparatus $59_{\#1}$, $59_{\#2}$, the data demodulation apparatus $60_{\#1}$, $60_{\#2}$ and the data synthesizing apparatus 61 are the same as that of the preamble spread code detecting apparatus 35, the spread code synchronization establishing apparatus 37, the information transmission spread code

generator $38_{\#1}$, $38_{\#2}$, the reverse spreading apparatus $36_{\#1}$, $36_{\#2}$, the data demodulating apparatus $39_{\#1}$, $39_{\#2}$ and the data synthesizing apparatus 40. In this example it is arranged that the data which are divided in two portions and sent from the mobile station #1 at a time, are combined in one by the data synthesizing apparatus 61 and output to the data flow control apparatus 3.

[Second example of a structure for the transmitter of the mobile station #2]

Fig. 14 is a block diagram which shows a second example of a structure for a transmitter of the mobile station #1. In this example, it is arranged that the transmitter comprises the information transmission spread code generator $62_{\#1}$ - $62_{\#4}$ and spread code selecting apparatus 63, and the transmitter can achieve the uplink of the information from the mobile station #1 to the base station 1 using 4 channels at a time. The data output from the upper application layer 41 is divided in four portions. To the respective portions of the four divided data, the information transmission spread code which are generated by the information transmission spread code generator $62_{\#1}$ - $62_{\#4}$ are assigned by the spread code selecting apparatus 63.

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The spread code selecting apparatus 63 outputs the information transmission spread code data to the spread code selecting apparatus 54 based on the information transmission spread code data which are output from the information transmission spread code generator $62_{\#1}$ - $63_{\#4}$ and the data which are output from the upper application layer 41. The spread code selecting apparatus 54 combines the data of the preamble block 19 and the data of the information block 20 based on the FRAME ~~flame~~ structure controlling apparatus 52, and makes the one FRAME ~~flame~~ 18. Then the spread code selecting apparatus 54 outputs the data of the one FRAME ~~flame~~ 18 to

the D/A converter 55. The D/A converter 55 converts the data of the one ~~flame~~ FRAME 18 to an analog signal. The analog signal is modulated by the RF. IF circuit 33 and transmitted (uplink) to the base station 1.

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According to the transmitter of the mobile station #1 shown in Fig. 14, it is arranged that the information is sent using four channels at a time.

[Second example of a structure for the AS-receiver 7 of the base station 1]

Fig. 15 is a block diagram which shows a second example of structure for an AS-CDMA receiver $7_{\#1}$ of the base station 1. This AS-receiver 7 is made to receive data of the one ~~flame~~ FRAME 18 sent from the transmitter of the mobile station #1 shown in Fig. 14.

In components which constitute the AS-CDMA receiver $7_{\#1}$, the same components as the AS-CDMA receiver $7_{\#1}$ which is shown is Fig. 13, are designated at the same numerals, and detailed description will be omitted for the same components and only different components will be explained.

The AS-CDMA receiver $7_{\#1}$ which is shown in Fig. 15, comprises the integral networks $63_{\#1}$, $63_{\#2}$, $63_{\#3}$ and $63_{\#4}$, the integral signal comparing apparatus 64 and the data demodulating apparatus 65.

The function of the integral networks $63_{\#1}$, $63_{\#2}$, $63_{\#3}$ and $63_{\#4}$, the integral signal comparing apparatus 64 and the data demodulating apparatus 65 are the same as that of the integral networks $42_{\#1}$, $42_{\#2}$, $42_{\#3}$ and $42_{\#4}$, the integral signal comparing apparatus 43 and the data demodulating apparatus 44 shown in Fig. 7. The data which are sent using four channels from the mobile station #1, are combined to one portion by the data demodulating apparatus 65, and output to the data flow control apparatus 3.

base station 1, the base station 1 is made to receive the transmission from the mobile station #2 after a delay of τ 2 (2 τ 1).

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According to these facts, though a communication (downlink) is made from the base station 1 to the respective mobile stations #1 - #3 at a time, the respective top ends F of the one ~~flame~~ FRAME 18 which are returned from the respective mobile stations #1 - #3 have a discrepancy as shown in Fig. 17(b) during the uplink.

When the top ends F of the one ~~flame~~ FRAME 18 have a discrepancy during the uplink, it is difficult for the base station 1 of the respective mobile stations #1 - #3 to control a time management.

To avoid this problem, the respective AS-CDMA receivers $7_{\#1}$ of the base station 1 are designed to have a structure as shown in Fig. 18. This AS-CDMA receiver $7_{\#1}$ comprises an uplink receiver 67, a receiving correlation apparatus 68, a receiving timing detecting apparatus 69, a most suitable timing calculating apparatus 70 and a transmission timing control information inserting apparatus 71. In this embodiment, the downlink transmitter 6 is also the packet CDMA transmitter and it is commonly used by all the mobile stations #i.

When a transmission (downlink) is made to the mobile stations #i from the base station 1, for example to the mobile station #1, the information is received by the mobile station #1 with time delay of τ 1. The base station 1 receives a transmission (uplink) from the mobile station #1 with time delay of τ 1, too. The information is converted from analog to digital by the A/D converter 72, and input through the TDD changing apparatus 72 and the distributing apparatus 8 to the uplink receiver 67 and the receiving correlation apparatus 68. The uplink receiver 67 is provided with, for example, the preamble spread code detecting apparatus

56, the spread code synchronization establishing apparatus 57, the information transmission spread code generator $58_{\#1}$, $58_{\#2}$, the reverse spreading apparatus $59_{\#1}$, $59_{\#2}$, the data demodulation apparatus $60_{\#1}$, $60_{\#2}$ and the data synthesizing apparatus 61. The uplink receiver 67 achieves a function to demodulate the data transmitted from the mobile station #1.

The receiving correlation apparatus 68 is composed by, for example, a matched filter which detects a correlation. The receiving correlation apparatus 68 detects a correlation of the data. The correlation signal of it is input to the receiving timing detection apparatus 69. The receiving timing detection apparatus 69 calculates the time delay $2\tau 1$ between the base station 1 and the mobile station #1 based on the correlation signal, and outputs the result to the most suitable timing calculating apparatus 70.

The most suitable timing calculating apparatus 70 calculates the most suitable timing which is required by the base station 1 based on the delay time $2\tau 1$, and outputs the result to the transmission timing control information inserting apparatus 71.

Herein, the term transmission timing control information means a control information to control the transmission timing of the mobile station #1. The transmission timing control information inserting apparatus 71 outputs a transmission timing control information of chip level to the downlink transmitter 6. The downlink transmitter 6 makes data consisting of the one ~~flame~~ FRAME 15 including, for example, the barker code 13 shown in Fig. 2 in which the timing control information of chip level is inserted. The data consisting of the one ~~flame~~ FRAME 15 are output through the TDD changing apparatus 9 to the D/A converter 30. The D/A converter 30 converts the data from that of digital to that of analog. The converted

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transmitter 74. The uplink transmitter 74 transmits the data which are sent from the upper application in accordance with the transmission timing control information. The data which are output from the uplink transmitter 74 are converted from the digital form to the analog form by the D/A converter 75. The converted analog data are modulated by the frequency modulation method by the RF. IF circuit 33, and transmitted to the base station 1.

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According to the second example, the delay time τ which is caused by the difference of distance from the mobile station #1 to the base station 1, is calibrated based on the transmission timing control information. By this arrangement, the discrepancy of top end portion F of the one ~~flame~~ FRAME 18 which is caused by the difference of distance from the mobile station #1 to the base station 1, can be prevented and the time base of all the mobile stations #i can be calibrated to the time base of the base station 1.

Also by this arrangement, it is convenient for a case when the information of the respective channels of #1 - #N are sent by the arithmetic addition.

[Embodiment 3]

There are various kinds of obstacles on a way of the radio wave from the base station 1 to the mobile station #i. Because of this, even though the information is sent on a carrier wave with frequency f from the base station 1, the carrier wave with frequency $f + \Delta f$ is received at the mobile station #i as a component of frequency error is mixed. When the information is received in a situation under the frequency with $f + \Delta f$ is mixed, there is a fear that the cross talk may happen between the respective mobile stations.

For example, even when the information is sent from the base